Fiber-based platform for synchronous imaging of endogenous and exogenous fluorescence of biological tissue.

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Public Summary:
Fluorescence from natural tissue components and that from foreign dyes used to label biological samples encode complementary information. Here we report the first results from an optical imaging instrument that captures both types of fluorescence from tissue samples using a single flexible multimode optical fiber that delivers laser light beam from the source to the tissue and collects the emitted fluorescence light from the tissue to the detector. A custom-built reflective optical chopper wheel with mirror-like blades and air gaps in-between rotates in synchrony with the laser pulses to interleave the two types of fluorescence sending it towards two different detection systems. The natural tissue fluorescence is detected by a fluorescence lifetime imaging apparatus, and the fluorescence from the dye goes to a photoreceiver tailored to imaging green fluorescent protein for intensity-based fluorescence measurements. We demonstrate the functionality of this instrument imaging dyes with different spectra and lifetime signatures, and resolving areas with cellular content on bio-engineered tissue constructs.

Scientific Abstract:
Endogenous and exogenous fluorescence emission from biological samples encodes complementary information. Here we report, to the best of our knowledge, the first results from an optical imaging platform with interleaved excitation and detection of exogenous and endogenous fluorescence from tissue samples using a single flexible multimode fiber that delivers the excitation beam and collects the emitted light. A custom-built reflective optical chopper wheel with synchronized rotation temporally multiplexes an autofluorescence lifetime imaging apparatus with an intensity-based fluorescence module tailored to imaging green fluorescent protein. We demonstrate the functionality of such platform imaging dyes of varying fluorescence signatures and resolving cellularized areas on bio-engineered tissue constructs.